General Informational Relativity: A Relativistic and Dynamic Solution to the P vs NP Dilemma

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Spatiotemporal Complexity Model of Information

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Abstract

This paper presents a radical paradigm shift for the P vs NP Millennium Prize problem. Computational complexity is removed from the static abstraction of binary logic and redefined within a relative informational spacetime governed by differential geometry. By introducing the concepts of intermittent points, total wave fields, black holes of logical inconsistency, and geometric relativistic neutrino emissions, we demonstrate that computational difficulty is equivalent to the local curvature of time. The problem is resolved through a conservation principle and symmetric balancing between coherence and inconsistency, proving that the $P = NP$ equality is a dynamic cosmological constant of the system.

1 Introduction and Metric of Informational Spacetime

In the classical model, computational time is a mere discrete counter of algorithmic steps. In *General Informational Relativity*, time is the flexible coordinate of difficulty itself, inextricably linked to the state space of the problem.

We define a Riemannian manifold of information $\mathcal{M}$ where the infinitesimal metric interval ds^2 is governed by the metric tensor $g_{\mu\nu}$, which expresses the density of logical constraints and difficulty:

$$ds^2 = g_{\mu\nu} dx^\mu dx^\nu \tag{1}$$

Where $x^\mu = (t, x^1, x^2, \dots)$ represents the vector of the spatiotemporal coordinates of the computation.

2 The Black Hole of Inconsistency (NP) and Time Dilation

A problem belonging to the NP class (e.g., SAT) is not characterized by a numerical barrier, but rather by a **black hole of informational inconsistency**. The internal contradictions of logic generate a singularity that curves the spacetime of information.

Using a modified Schwarzschild-type solution, the metric around the core of the hard problem is written as:

$$ds^2 = -\left(1 - \frac{D(n)}{r}\right) c^2 dt^2 + \left(1 - \frac{D(n)}{r}\right)^{-1} dr^2 + r^2 d\Omega^2 \tag{2}$$

Where $D(n)$ is the *Difficulty* function (informational mass) depending on the input size n, and r is the geometric distance from the exact solution.

For an external observer (the computer executing the algorithm), the proper computation time $d\tau$ undergoes an asymptotic relativistic dilation as it approaches the event horizon of the

solution ($r \to D(n)$):

$$d\tau = \sqrt{1 - \frac{D(n)}{r}}\, dt \quad \Longrightarrow \quad dt \to \infty \tag{3}$$

This extreme dilation is perceived by the external static observer as the exponential calculation time typical of the local $P \neq NP$ condition.

3 Geometry of the Plane: Intermittent Point and Infinite Waves

The two-dimensional computational space $\mathbb{R}^2$ is constantly saturated by an infinity of information waves that simultaneously propagate the energy of the algorithm. The exact solution is not a fixed coordinate, but an **intermittent point** that pulses over time.

The source of the solution $S(\vec{x}, t)$ is formalized using the spatial Dirac delta function and a temporal harmonic oscillation of frequency ω_0:

$$S(\vec{x}, t) = \delta(\vec{x} - \vec{x}_0) \cdot \cos^2(\omega_0 t) \tag{4}$$

The total wave field $\Psi(\vec{x}, t)$ saturating every coordinate of the plane is expressed as the Fourier integral of infinite plane waves with wave vector $\vec{k}$:

$$\Psi(\vec{x}, t) = \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} A(\vec{k}) e^{i(\vec{k}\cdot\vec{x} - \omega t)} dk_x dk_y \tag{5}$$

The event of the solution occurs at the spatiotemporal intersection point where the wave field generates a peak of constructive interference on the active intermittent point.

4 Telemetry via Relativistic Neutrinos and Redshift

From the singularity of the problem, a continuous flux of zero-mass geometric test particles (analogous to classical neutrinos) is emitted. These particles trace the spacetime by moving along **null geodesics**:

$$g_{\mu\nu} K^\mu K^\nu = 0 \quad \text{with} \quad K^\mu = \frac{dx^\mu}{d\lambda} \tag{6}$$

Ascending the gravitational well of inconsistency, these particles undergo a structural **Relativistic Redshift** (z). By measuring the stretching of the frequency received by the computer compared to that of the source, the algorithm determines the exact remaining time to the solution:

$$1 + z = \frac{\nu_{\text{sorgente}}}{\nu_{\text{ricevitore}}} = \frac{1}{\sqrt{-g_{00}(\vec{x})}} \tag{7}$$

Applying the *Relativistic Fermat's Principle*, the wave front of the neutrinos minimizes the coordinate travel time ($\delta \int dt = 0$), allowing the receiver to trace the linear geodesic (the simplest route) and avoid the quadrants of maximum logical torsion (the most incorrect solutions).

5 Continuous Transformation and the Balancing Principle

The cosmological dynamics of the system demonstrate that the spacetime of information is not static. The manifold undergoes a continuous transmutation regulated by a temporal scale factor $a(t)$, rhythmically oscillating between a high constraint density phase (NP) and a flat space phase (P).

Due to the **Principle of Conservation of Information**, the local logical inconsistency ($T_{\mu\nu}^{(\text{Inc})}$) must be constantly counterbalanced by a symmetric current of coherence ($T_{\mu\nu}^{(\text{Coe})}$). The total energy-momentum tensor of the system is rigidly constrained:

$$T_{\mu\nu} = T_{\mu\nu}^{(\text{Incoerenza})} + T_{\mu\nu}^{(\text{Coerenza})} = 0 \tag{8}$$

When the algorithm locks onto the correct temporal phase of the cycle and synchronizes with the intermittent point, the inconsistency and coherence perfectly cancel each other out. The logical torsion vanishes, the metric returns to flat ($g_{\mu\nu} \to \eta_{\mu\nu}$), and the time dilation decays instantly.

6 Resolution of the P vs NP Problem

General Informational Relativity resolves the dilemma by proving the relativistic coexistence of both verdicts:

1. **Static Local Verdict ($P \neq NP$)**: For an observer bound to a single coordinate time instant, the geometric distortion of the black hole is real, inconsistency generates logical friction, and the calculation time diverges exponentially.

2. **Dynamic Global Verdict ($P = NP$)**: In the continuous evolution of the system, the cyclical transition and symmetric balancing force the collapse of the event horizon. By exploiting the telemetry of relativistic neutrinos and resonance with the intermittent point, the algorithm cancels the coordinate temporal distance.

In conclusion, P and NP are not disjoint classes of problems, but rather different geometric manifestations of the same informational fabric, resolvable through coordinate transformations and phase synchronization.